Saskatchewan
Agriculture
and Food

2002 Saskatchewan Forage Crop Production Guide

Contents

Forage Selection 1
Relative Yield of Varieties of Perennial Grasses, 2002 3
Relative Yield of Varieties of Alfalfa, 2002 4
Relative Yield of Varieties of Forage Legumes, 2002 4
Alfalfa Variety Characteristics 5
Recommended Seeding Rates for Various Soil Zones 6
Forage Mixtures 7
Alfalfa Cutting Management 7
Comparative Seed Size of Forage Species 7
Seed Quality 8
Calculating Seeding Rates 8
Steps to Successful Seeding 9
Seeding Dates 9
Row Spacing 10
Weed Control in Forage Crops 10
Inoculation of Legumes 10
Using Annual Crops for Forage. 11
Soil Zones of Saskatchewan 12
Annual Ryegrass for Pasture in Saskatchewan 13
Fertilizing Forages 13
Perennial Forages for Saline Soils, Flooded Areas and Peat 14
Seeding Forages in Saline Areas 15
Land Reclamation 15
Improved Grazing Management: More Pasture for More Months 16
Steps in Planning a Grazing System 17
Relative Yield and Period of Growth of Native Grass and Seeded Pastures 18
Haying – Cutting for Maximum Quantity and Quality 18
Bloat 18
Nitrate Poisoning 19
Acknowledgments 20
References 20

Forage Selection

Selection of an appropriate forage species is an important first step in successful forage production. Factors such as soil type, salinity, flooding, desired season of use, longevity of species, end use, quality and yield potential should be considered to make the best choice possible. Descriptions of several forage species adapted to Saskatchewan growing conditions are given below.

Grasses

Smooth Bromegrass - (*Bromus inermis*)
A long-lived aggressively creeping grass best suited to hay production. Tolerant of moderate periods of spring flooding, saturated soils and saline conditions. Recommended for Dark Brown, Black and Grey-Wooded soil zones. Smooth bromegrass can be invasive in some areas, spreading by seed and rootstocks. Integrity of natural areas are compromised when invaded by introduced species. Consider planting a less aggressive species when seeding adjacent to natural areas.

Meadow Bromegrass - (*Bromus riparius*)
Weakly creeping pasture grass with rapid regrowth characteristics. Can be used for hay, but harvest can be difficult due to basal growth form. Similar in adaptation to smooth bromegrass, but not quite as hardy under stress conditions. Produces few seed heads in older stands.

Altai Wildrye Grass - (*Leymus angustus*)
Long-lived, hardy, saline-tolerant pasture grass, that is moderately creeping, but has a bunched appearance in the field. Well adapted to medium and heavy textured soils. Intolerant of spring flooding and saturated soils, it is drought tolerant and adapted to all soil zones. Cures well for good fall and winter forage quality. It is difficult to establish due to poor seedling vigour.

Dahurian Wildrye Grass - (*Elymus dahuricus*)
A productive, short-lived, shallow-rooted bunchgrass. Highly competitive and quick to establish, it has produced well under saline conditions. Adapted to all soil zones. With good growth conditions, it can produce a crop in the year of seeding.

Russian Wildrye Grass - (*Psathyrostachys juncea*)
Long-lived, drought tolerant, hardy pasture grass. Good salt and drought tolerance but poor tolerance to spring flooding and saturated soils. Begins growth early in spring but also provides good late season forage due to good stem curing characteristics. It is difficult to establish due to seedlings that do not compete well with weeds or cover crops. The variety Swift, and to a lesser degree, Tetracan, have exhibited improved seeding vigour over other varieties. Is adapted to all soil zones.

Crested Wheatgrass - (*Agropyron cristatum*)
Hardy bunchgrass that is extremely long-lived and drought tolerant. Particularly well adapted to sandy soils, it is intolerant of spring flooding and saturated soils, although it is moderately salt tolerant. It can be used for hay or pasture but is especially useful as early spring pasture. Palatability of forage declines as growing season advances.

Fairway-Parkway types are finer-stemmed and tolerate more moisture, making them better suited to the Black and Grey-Wooded soil zones than Summit-Nordan types. Crested wheatgrass, spreads by seed onto adjacent rangeland in some areas. Biodiversity and function of natural areas are compromised when invaded by introduced species. Consider planting a less aggressive species when seeding adjacent to natural areas.

Intermediate Wheatgrass - (*Thinopyrum intermedium*)
High-yielding, creeping-rooted hay grass. Matures slowly, making it an ideal candidate for hay mixes containing alfalfa. Adapted to all soil zones, it is moderately tolerant of salinity, spring flooding and saturated soils. It is short-lived under intensive use.

Slender Wheatgrass - (*Elymus trachycaulus*)
Is a short-lived native grass that is salt tolerant. It has moderate to good spring flooding tolerance and is moderately tolerant of saturated soils. Establishes very quickly although it is not very palatable to livestock.

Streambank Wheatgrass - (*Elymus lanceolatus subsp. riparium*)
Is a vigorous, low-growing native sod former. Has good spring flooding and drought tolerance and is moderately tolerant of salinity and saturated soils. Is mainly used for reclamation.

Western Wheatgrass - (*Pascopyrum smithii*)
A native sod former with good flooding, salinity and drought tolerance. Forage quality is good and makes good summer and fall pasture. Adapted to all soil zones.

Northern Wheatgrass - (*Elymus lanceolatus*)
Is a native sod former with good drought tolerance. It has high energy levels and cures well on the stem, making it suitable for late season and winter pasture. Adapted to all soil zones.

Tall Wheatgrass - (*Thinopyrum ponticum*)
Is a bunchgrass that is long-lived and very saline, spring flooding and saturated soil tolerant. Is ideal for planting on areas with high salinity levels. Can be cut for hay but has low palatability.

Reed Canarygrass - (*Phalaris arundinacea*)
Long-lived flood and saturated-soil tolerant native sod former. Is not salt tolerant. A high yielder that has good acceptance by livestock with use of a low alkaloid variety.

Timothy - (*Phleum pratense*)
A spring-flooding and saturated-soil tolerant bunchgrass that is well suited to peat soils. Is not drought or salinity tolerant. Is moderately persistent in Black and Grey-Wooded soil zones and under irrigation in Saskatchewan.

Creeping Red Fescue - (*Festura rubra*)
Strongly creeping low-growing pasture grass. It is intolerant of drought conditions and is moderately persistent in the Black and Grey-Wooded soil zones and irrigation.

Kentucky Bluegrass - (*Poa pratensis*)
Is a long-lived grass that is low-growing and creeping-rooted. Adapted to high moisture conditions. Is grazing tolerant and increases on overgrazed pastures in the parkland.

Orchardgrass - (*Dactylis glomerata*)
A highly palatable bunchgrass with excellent regrowth and mid-season production potential. Persistent only under irrigation and high moisture conditions.

Meadow Foxtail - (*Alopecurus pratensis*)
A long-lived, somewhat sod-forming grass adapted to cool, moist sites. Very early growing, it has excellent flooding tolerance but is not salt tolerant.

Creeping Foxtail - (*Alopecurus arundinaceus*)
A long-lived, strongly creeping rooted grass. It begins growth early, and has excellent flooding tolerance, but is not drought tolerant. Resembles meadow foxtail, but has longer rhizomes and wider leaves.

Legumes

Alfalfa - (*Medicago sativa*)
A widely-adapted productive legume. Tap-rooted types are well suited to hay production. Creeping-rooted types are hardier and are more persistent under grazing or harsh growing conditions. Is moderately saline tolerant but is intolerant of acidity, spring flooding and saturated soils. Causes bloat in livestock.

Sainfoin - (*Onobrychis viciifolia*)
Is a bloat-safe perennial legume with good drought tolerance. Is adapted to areas where alfalfa grows but is not as persistent. Is intolerant of salinity, spring flooding and saturated soils. Has slow regrowth but is a highly palatable hay or pasture crop. Production potential is 80-85 per cent of alfalfa.

Birdsfoot Trefoil - (*Lotus corniculatus*)
Is a bloat-safe, moderately persistent, perennial legume. Has moderate salinity tolerance and good tolerance to spring flooding, saturated and acid soils. Is not competitive with weeds or other forage species.

Alsike Clover - (*Trifolium hybridum*)
A short-lived perennial legume with high tolerance to spring flooding and saturated or acid soils. Not tolerant of drought or salinity. Adapted to the Grey-Wooded soil zone. Can cause bloat in livestock.

Red Clover - (*Trifolium pratense*)
A short-lived, acid soil tolerant perennial legume. Is moderately tolerant of spring flooding and saturated soils but is intolerant of drought and salinity. Is not persistent as pasture, and hay is slow-drying due to high water content of foliage. Adapted to the Grey-Wooded soil zone. Can cause bloat in livestock.

Sweet Clover - (*Melilotus ssp.*)
A hardy, drought and salinity tolerant biennial adapted to a wide range of soil types. Intolerant of spring flooding and saturated soils. Low coumarin varieties should be used to reduce the risk of bleeding disease in livestock. Can cause bloat.

Cicer Milkvetch - (*Astragalus cicer*)
A long-lived, non-bloat legume adapted to the moist Dark Brown, Black and Grey-Wooded soil zones. Is slow to establish but persists under grazing.

Relative Yield* of Varieties of Perennial Grasses, 2002

Grass	Varieties	Relative Yield (% of check) Soil Zones (see map page 12) 1	2	3	Irr.
Smooth Bromegrass	Signal	102	97	93	97
	Carlton	100	100	100	100
	Magna	93	93	99	100
	Baylor	90	90	92	96
	Raddison	99	-	102	106
	Rebound	94	94	94	101
Yield of Carlton (kg/ha)		**3496**	**6004**	**4968**	**11972**
Meadow Bromegrass**	Fleet	100	100	100	100
	Paddock	109	105	100	97
	Regar	105	95	95	90
Yield of Fleet (kg/ha)		**3396**	**5250**	**4545**	**9585**
Hybrid Bromegrass***	**AC Knowles**	-	**6431**	**6251**	**15734**
Altai Wildrye Grass	Prairieland	100	100	100	100
	Eejay	101	89	96	102
	Pearl	90	98	90	92
Yield of Prairieland (kg/ha)		**2540**	**5156**	**4545**	**10690**
Dahurian Wildrye Grass	James	100	100	100	100
	Arthur	92	104	95	101
Yield of James (kg/ha)		**2946**	**5474**	**5558**	**11203**
Russian Wildrye Grass	Tetracan	100	95	96	96
	Swift	100	100	100	100
	Mayak	107	94	103	106
Yield of Swift (kg/ha)		**2165**	**4665**	**3814**	**9726**
Crested Wheatgrass	Kirk	100	100	100	100
	Fairway	104	95	86	96
	Parkway	106	96	93	98
	Nordan	94	93	98	95
Yield of Kirk (kg/ha)		**3555**	**5302**	**5172**	**12008**
Intermediate Wheatgrass	Chief	100	100	100	100
	Clarke	100	95	88	93
	Greenleaf (pubescent)	91	94	99	92
Yield of Chief (kg/ha)		**4150**	**5558**	**5496**	**12101**
Slender Wheatgrass	Revenue	100	100	100	100
	Adanac	102	107	107	111
Streambank Wheatgrass	Sodar	76	70	66	73
Tall Wheatgrass	Orbit	100	83	78	117
Northern Wheatgrass	Elbee	89	77	71	86
Western Wheatgrass	Walsh	72	58	70	77
Yield of Revenue (kg/ha)		**3658**	**4493**	**5112**	**10414**
Reed Canarygrass	Vantage	100	100	100	100
	Venture	100	98	95	96
	Rival	89	95	94	88
	Palaton	96	98	96	94
Yield of Vantage (kg/ha)		**1650**	**4957**	**5015**	**12602**
Timothy	Climax	–	–	–	100
	Champ	–	–	–	100
	Basho	–	–	–	100
Creeping Red Fescue	Boreal	–	–	–	77
Kentucky Bluegrass	Troy	–	–	–	83
Orchardgrass	Kay	–	–	–	80
Yield of Climax (ka/ha)		–	–	–	**10159**

* Relative yield data supplied by the Saskatchewan Forage Council's Variety Testing Program, with support from Agriculture Development Fund, Irrigation Based Economic Development/Partnership Agreement on Water Based Economic Development, and Agriculture and Agri-Food Canada.

** Limited long-term adaptation information available for the Brown soil zone.

*** Actual yields, kg/ha

Relative Yield of Varieties of Alfalfa, 2002

Alfalfa	Variety	Relative Yield (% of check) Soil Zones (see map, page 12) 1	2	3	Irr.
		% Rambler	% Beaver	% Beaver	% Barrier
	AC Grazeland Br*	110	97	103	105
	AC Nordica	–	–	–	–
	Algonquin	111	96	101	91
	Alouette	109	104	99	–
	Apica	120	102	99	94
	Atomic	87	-	103	109
	Barrier	100	99	98	100
	Beaver	114	100	100	83
	Cut 'N' Graze	–	86	111	101
	Dekalb 120	106	104	98	–
	Heinrichs	99	100	101	93
	Magnum IIIWet	92	-	100	101
	OAC Minto	110	100	103	93
	Oneida VR	–	–	–	–
	Peace	–	97	97	–
	Profit	–	–	95	–
	Proleaf	–	116	107	113
	Quattro HR	–	107	102	95
	Rambler	100	94	100	83
	Rangelander	108	93	94	88
	Roamer	87	99	103	–
	Spreador 2	–	–	100	–
	Stockwell	–	–	99	111
	Surpass	–	–	97	–
	Survivor	89	–	87	109
	True North	–	109	106	106
	Vernal	109	91	98	94
	WL252HQ	–	96	110	103
	WL 324	98	–	–	–
	53Q60	91	92	108	106
	53V08	–	100	100	108

For infromation on seed surces, consult the Saskatchewan Seed Growers Association's Seed Guide or your local dealer.

Relative Yield of Varieties of Forage Legumes, 2002

Legume	Variety	Relative Yield (% of Nova Sainfoin) Soil Zones (see map, page 12) 1	2	3	Irr.
Sweet Clover	Norgold	161	108	112	–
Red Clover	Altaswede	–	–	77	–
	Norlac	–	–	70	–
Alsike Clover	Aurora	–	–	60	–
	Dawn	–	–	60	–
Sainfoin	Nova	100	100	100	–
Birdsfoot Trefoil	Cree	–	–	71	–
	Leo	–	–	77	–
Cicer Milkvetch	Oxley (Check)	100	100	100	100
	Windsor (% Oxley)	113	117	119	124

For information on seed sources, consult the Sask Seed Growers Association's *Seed Guide* or your local dealer.

* Please note that AC Grazeland Br reduces, but does not eliminate the incidence of bloat. Agriculture and Agri-Food Canada, Saskatchewan Wheat Pool nor Pickseed Canada Inc. warrant that AC Grazeland Br is a non-bloating variety.

Alfalfa Variety Charateristics

Variety	Rooting Pattern	Cold Tolerance or Persistence	Recovery After Cutting	Disease Resistance *	Use
AC Grazeland Br	tap	good	medium	5	pasture
AC Nordica	tap	very good	slow	1, 2, 5	hay
Algonquin	tap	good	medium	3, 5	hay
Alouette	tap	medium	rapid	5	hay
Apica	tap	medium	rapid	5	hay
Atomic	tap	medium	–	1, 2, 4, 5	hay
Barrier	tap	medium	rapid	4, 5	irr. hay
Beaver	tap	good	medium	3, 5	hay
Cut 'N' Graze	tap	very good	rapid	1, 5	hay or pasture
Dekalb 120	tap	medium	medium	5	hay
Heinrichs	creeping	excellent	slow	1, 5	hay or pasture
Magnum III Wet	branched	–	rapid	1, 4, 5	hay
OAC Minto	tap	medium	rapid	5	hay
Oneida VR	tap	medium	medium	4, 5	irr. hay
Peace	tap	good	rapid	–	hay
Profit	tap	medium	medium	1, 4, 5	hay
Proleaf	tap	medium	rapid	1, 4, 5	
Quattro HR	tap	medium	rapid	1, 4, 5	hay
Rambler	creeping	very good	slow	1, 3, 5	hay or pasture
Rangelander	very strongly creeping	very good	slow	–	hay or pasture
Roamer	creeping	very good	slow	3, 5	hay or pasture
Spreador 2	creeping	very good	slow	5	pasture or hay
Stockwell	tap	medium	rapid	1, 4, 5	hay
Surpass	tap	medium	medium	1, 5	hay
Survivor	–	–	–	–	–
True North	tap	good	medium	1, 4, 5	hay
Vernal	tap	medium	medium	3, 5	hay
WL252 HQ	tap	medium	medium	–	hay
WL 324	–	–	–	–	–
53Q60	tap	very good	slow	1, 2, 4, 5	hay or pasture
53V08	tap	excellent	medium	1, 2, 4, 5	hay

*Diseases: 1. crown rot 2. winter crown rot 3. downy mildew 4. verticillium wilt 5. bacterial wilt

Recommended Seeding Rates for Various Soil Zones

Soil Zone (see map on page 12)	Crops	Seeding Rate lb./acre or kg/ha
1. **Brown**	**Hay Crops** (seed grass and legume in alternate rows)	
	Crested wheatgrass and alfalfa	3 + 2
	Intermediate wheatgrass and alfalfa	4 + 2
	Alfalfa	4
	Sweetclover	8
	Pastures (cross-seed)	
	Altai wildrye grass and alfalfa (high water table or saline seep areas only)	8 + 1
	Crested wheatgrass and alfalfa	3 + 1
	Russian wildrye grass and alfalfa	3 + 1
	Meadow bromegrass* and alfalfa	8 + 1
2. **Dark Brown**	**Hay Crops** (alternate rows)	
	Smooth bromegrass and alfalfa	5 + 4
	Crested wheatgrass and alfalfa	5 + 2
	Intermediate wheatgrass and alfalfa	8 + 2
	Alfalfa	8
	Sweetclover	8
	Pastures (cross-seed)	
	Altai wildrye grass and alfalfa (high water table or saline seep areas only)	8 + 1
	Crested wheatgrass and alfalfa	4 + 1
	Russian wildrye grass and alfalfa	3 + 1
	Meadow bromegrass and alfalfa	9 + 1
	Smooth bromegrass and alfalfa	7 + 1
	Alfalfa (Caution: risk of bloat)	8
3. **Black and Grey-Wooded**		**Hay Crops**
	Smooth bromegrass and alfalfa	4 + 5
	Crested wheatgrass and alfalfa	6 + 3
	Intermediate wheatgrass and alfalfa	11 + 3
	Alfalfa	8
	Sweetclover	8
	Meadow bromegrass	12
	Meadow bromegrass and alfalfa	10 + 2
	Pastures	
	Meadow bromegrass and alfalfa	10 + 1
	Meadow bromegrass	12
	Smooth bromegrass and alfalfa	7 + 1
	Crested wheatgrass and alfalfa	6 + 1
	Intermediate wheatgrass and alfalfa	11 + 1
	Russian wildrye grass	6
	Sainfoin (non-bloating)	30
	Birdsfoot trefoil (non-bloating)	4
Irrigation	**Hay Crops**	
	Smooth bromegrass and alfalfa	6 + 5
	Intermediate wheatgrass and alfalfa	11 + 5
	Alfalfa	8
	Pastures	10 + 1
	Bromegrass and alfalfa	8 + 1
	Intermediate wheatgrass and alfalfa	11 + 1
	Kentucky bluegrass and alfalfa	2 + 1
	Meadow bromegrass	12
	Orchardgrass	10

*Limited data is available on the longevity of meadow bromegrass in the Brown soil zone.

Notes:

- Seeding rates may be varied based on seed quality and cost, seeding conditions and end use of the crop.
- When seeding grass alone for pasture in the Brown and Dark-Brown soil zones, increase grass recommended rate by 1.5 x. If Tetracan Russian wildrye grass is used increase seeding rate by 2 x. If Fairway or Parkway crested wheatgrass is used reduce seeding rates by 20%. Higher seeding rates may be appropriate where alfalfa is sown for dehy, or where a thick stand of fine stemmed alfalfa is required. However, research in Saskatchewan, Manitoba and North Dakota indicates that seeding more than about 8 lb/a does not result in greater forage yields in alfalfa.

Crop	Approx. No. of Seeds/kg	Approx. No. of Seeds/lb.	Crop	Approx. No. of Seeds/kg	Approx. No. of Seeds/lb.
LEGUMES			Intermediate wheatgrass	194,000	88,000
Alfalfa	440,000	200,000	Pubescent wheatgrass	220,000	100,000
Sweetclover	572,000	260,000	Slender wheatgrass	352,000	160,000
Alsike clover	1,540,000	700,000	Streambank wheatgrass	344,000	156,000
Red clover	605,000	275,000	Tall wheatgrass	174,000	79,0900
White clover	1,760,000	800,000	Kentucky bluegrass	4,800,000	2,182,000
Birdsfoot trefoil	825,000	375,000	Smooth bromegrass	300,000	136,000
Sainfoin	66,000	30,000	Meadow bromegrass	176,000	80,000
Cicer milkvetch	286,000	130,.000	Creeping red fescue	1,353,000	615,000
GRASSES			Meadow fescue	506,000	230,000
Russian wildrye grass (diploid)	385,000	175,000	Tall fescue	500,000	227,000
Russian wildrye grass (tetraploid)	220,000	100,000	Meadow foxtail	1,270,000	577,000
Altai wildrye grass	112,000	51,000	Creeping foxtail	1,657,000	753,000
Crested wheatgrass (diploid)	485,000	220,000	Orchardgrass	1,439,000	654,000
Crested wheatgrass (tetraploid)	385,000	175,000	Timothy	2,710,000	1,232,000
Dahurian wildrye grass	175,000	80,000	Reed canarygrass	1,175,000	534,000
Northern wheatgrass	341,000	155,000	Italian ryegrass (Maris Ledger)	210,000	105,000
Western wheatgrass	242,000	110,000	Westerwolds ryegrass	210,000	105,000

Forage Mixtures

Forages can be planted in monocultures or mixtures. Mixtures can be simple or complex, with two to many species composing a mix. Often, planting a forage mixture provides advantages to seeding a single species. Some advantages of forage mixtures are as follows:

- better adaptation across fields that have diverse topography, soil types, or salinity levels.
- forage production is more consistent across the season, because each species production peaks at different dates
- more efficient use of soil moisture and nutrients, due to more diverse rooting patterns
- animal gains may be greater due to a more balanced diet
- mixed stands may have greater longevity, with more adapted species replacing less suited species over time
- less susceptibility to insect and disease infestations.

Forage monocultures have some advantages compared to forage mixtures:

- easier to seed
- more uniform palatability, thereby reducing selective grazing
- uniform growth and regrowth characteristics
- more stable plant composition
- more predictable peak production date
- often, only one species may be fully adapted to the site, or intended use.

Generally, monoculture forage crops are easier to manage successfully than forage mixtures. The most important point to remember when selecting a forage mixture is to select only species that are adapted to the site and complement the production characteristics of other species in the mix.

Weatheradio Canada		
Location	**VHF Frequency**	**Telephone**
Waseca	162.400 MHZ	–
Midale	162.400 MHZ	634-2833
North Battleford	162.475 MHZ	445-7000
Prince Albert	162.400 MHZ	929-2114
Regina	162.550 MHZ	780-5744
Saskatoon	162.550 MHZ	975-4266
Stranraer	162.400 MHZ	–
Kindersley	–	463-2031
Swift Current	162.550 MHZ	773-5599
Yorkton	162.550 MHZ	782-1511
Regina Beach	162.400 MHZ	780-5744
Lanigan	162.400 MHZ	–
Birsay	162.475 MHZ	–
Whitewood	162.475 MHZ	696-2229
Hudson Bay	–	865-2721
Ag Weather		773-5277
Weather Hotline ($1.95/min.)		1-900-451-4474
French language		780-5277

Alfalfa Cutting Management

Improper cutting management of alfalfa hay stands can lead to winter kill. Understanding alfalfa physiology can help avoid this problem.

Carbohydrates are produced in alfalfa leaves and used to fuel plant growth. Excess carbohydrates are moved down to the thick underground crown of the alfalfa plant. This carbohydrate is used as stored fuel, for two purposes: shoot regrowth after cutting, and plant maintenance over winter.

When an alfalfa plant is cut for hay, few leaves remain and the plant must draw on stored carbohydrate for regrowth. As a rule of thumb, the plant will need six weeks to replace the leaves and to replenish stored reserves to pre-cutting levels.

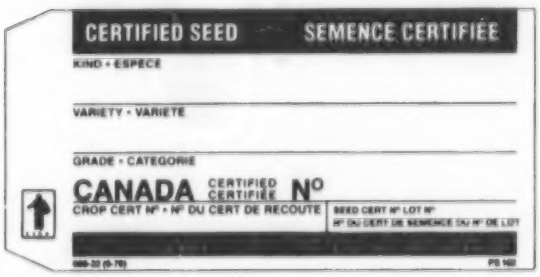
Plants cut after August 15 may not obtain six weeks of good growing weather before hard frosts to replenish their stored reserves, and can go into the winter with low carbohydrate levels. If the winter is severe, winter injury can result.

To reduce alfalfa winter kill:

- avoid cutting between August 15 and the first killing frost.
- seed recommended, winterhardy varieties.
- inoculate seed properly and maintain adequate soil phosphorous.
- manage stubble for maximum snow cover.

Seed Quality

Seed quality has a large impact on establishment success and subsequent forage yields. Certified seed will have good germination and seedling vigour, low amounts of weed seeds present, and be of a recognized variety. Certified seed assures the seed quality and the characteristics of the variety, such as relative yield, disease resistance and winter hardiness. This allows for selection of characteristics that best suit your growing conditions.



Crop Certificate Number

The first two digits represent the year in which the crop was produced. The third to the ninth digits inclusive represent the identification number of the grower who produced the seed. The tenth digit represents the code for them generation or class issued to the crop which produced the seed. The eleventh digit represents the number of different certificates of the same status issued to the grower.

Seed Certificate Number

This number is assigned by Canadian Food Inspection Agency, Agriculture and Agri-Food Canada for each lot of seed tagged by a Seed Inspector. There is a different number for each lot of seed.

Calculating Seeding Rates

For individualized seeding rates, use the following planning information to calculate seeding rates. Seeding rates should be calculated on the basis of Pure Live Seed (PLS). PLS determines the amount of viable seed in a seed lot by allowing for impurities and the germination percentage of the seed lot. PLS is calculated as follows:

PLS = (per cent Germination) x (per cent Purity). For example, if a seed lot has 15 per cent impurities and germination of 89 per cent, PLS would be: PLS = (0.89 x 0.85) = 0.76. Therefore, seeding rates should be increased by 24 per cent to obtain the desired density of viable seed. If 20-30 seeds per linear foot of row are desired, determine the number of seeds per pound of forage species from the Comparative Seed Size table on page seven. The number of linear feet per acre will be determined by row spacing as indicated in the table below.

Row Spacing	Linear Feet/a
6"	87,120
12"	43,560
18"	29,040
24"	21,780
X"	43,560 x 12 / X

Sample Calculation

Appropriate seeding rates will differ, depending on the soil zone. Generally, lower seeding rates are desirable in dry locations, to reduce inter-plant competition. Ideal seeding rates in Saskatchewan range from 20 seeds per square foot in the Brown soil zone, to over 40 under irrigation

1. Alfalfa in high moisture area with 6" row spacing:
   87,120 linear feet/ac x 20 seeds/linear foot = 9 lb/ac
   200,000 seeds/lb
2. Alfalfa in high moisture area with 12" row spacing:
   43,560 linear feet/ac x 30 seeds/linear foot = 7 lb/ac
   200,000 seeds/lb
3. Tetraploid crested wheatgrass and alfalfa in same row with 18" row spacing:
   CWG – 29,040 linear feet/ac x 15 seeds/linear foot = 3 lb/ac
   175,000 seeds/lb
   Alfalfa – 29,040 linear feet/ac x 15 seeds/linear foot = 2 lb/ac
   200,000 seeds/lb

Steps to Successful Seeding

1. Use quality seed. Clean seed with high germination will result in rapid establishment and reduced weed problems in the establishing crop.
2. Place seed at the correct depth. Most forage species should not be seeded deeper that one half inch. Some small seeded species, such as birdsfoot trefoil and timothy should be seeded at one quarter inch deep or less.
3. Seed into a firm seedbed. Good seed to soil contact is required for rapid germination of forage seeds. Soil should be firm enough that a footprint will leave virtually no depression in the soil. Clean, unworked stubble makes a good seedbed.
4. Meter seed accurately. Most forage seeds are small and/or chaffy, and are seeded at low rates. Seeding implements must be able to consistently apply seed. Mixing chaffy seed with cracked grain, cover crop seed, or fertilizer (not with inoculated legumes) can improve flow of seed.
5. Control weeds. Clean up fields prior to planting, paying particular attention to perennial weeds. Control weeds in-crop in the year of establishment using cultural or chemical means (consult Crop Protection Guide)
6. Use appropriate seeding rates. Ideal seeding rates vary with available precipitation. Seeding rates will be lower in drier parts of the province.
7. Seed at the correct row spacing. Six inch row spacings are recommended for the Black soil zone and irrigation, 18 inch row spacing are recommended for the Brown soil zone. Cross- seeding rows, or alternate row seeding of mixtures when seeding two species can also reduce competition.
8. Carefully consider the use of cover crops. Cover crops can protect forage seedlings from wind damage and provide an economic return in the year of establishment, however, cover crops compete with forage seedlings for moisture and nutrients, and usually reduce the subsequent yield of the forage. The negative impacts of cover crops on forage seedlings become more apparent under dry conditions, and may result in the forage failing to establish.
9. Remember that forage are slow to establish, and may require over a year to do so.

Seeding Dates

Forages should be sown to coincide with moisture and weather conditions that will assist germination and establishment. In general, perennial forages may be sown at three different times of the year.

Spring Seeding: This is usually the time when forage plantings are most likely to be successful. Generally soil moisture conditions are good. About 15 to 30 cm of moist soil is considered adequate for establishment. In the Brown and Dark Brown soil zones this time period will be from early April to mid-May.

In the Black and Grey-Wooded soil zones forage seedings may be successfully completed as late as mid-June. Usually early seeding is best, but consideration must also be given to field conditions, weed control and potential insect problems.

Late Fall Seeding: Seeding forage crops from October 15 until freeze-up generally ensures that no germination will occur until the following spring. Spring soil moisture conditions will likely be favourable from the infiltration of moisture from melted snow.

There is often more time in late fall than in early spring to prepare appropriate seeding equipment and to calibrate and set it for forage crops. Another advantage to 'dormant' seeding is that some land areas may not be accessible in the early spring, such as land subject to flooding, saline areas or peaty soils that remain wet in the summer. However, some crops such as sweet clover cannot be sown successfully in the late fall. Also, land may be subject to crusting resulting in poor emergence.

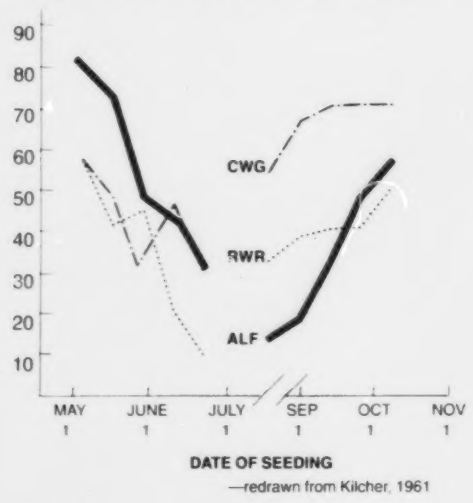
Early Fall Seeding: In some years there may be a 'window of opportunity' to seed forage crops in the early fall. Growing conditions must be correct for quick establishment as the plants must be developed to a stage to survive the winter.

Seedling legumes are much more susceptible to winterkill than seedling grasses. This requires that alfalfa be sown by mid-August. There is little information on seeding legumes other than alfalfa at this time of year. Grasses may be sown as late as September 10 in the Brown soil zone. Insects such as grasshoppers can be a threat to seedling forages in the fall.

Row Spacing

Hay yields in Brown soils (zone 1) can be increased in dry years by seeding at 45-60 cm row spacing. This increases crop height, making harvesting easier, compared to narrower row spacing (30 cm). Row spacing of 90 cm should only be used in seed production fields.

Effect of Seeding Date on Final Stands of Alfalfa, Crested Wheatgrass, and Russian Wildrye Grass (Swift Current)



—redrawn from Kilcher, 1961

Abbreviations:
CWG – Crested Wheatgrass
RWR – Russian Wildrye Grass
ALF – Alfalfa

Weed Control in Forage Crops

Good weed control prior to and during establishment is essential to get a rapidly established, clean forage stand. Nearly all forages have slowly developing, un- competitive seedlings. Weeds can easily out-compete forage seedlings for moisture and nutrients.

Weed competition results in increased time required for forage establishment, increased weediness of the subsequent forage stand, and, increased risk of establishment failure. Chemical weed control options in-crop are limited and expensive in forage, particularly to perennial weeds such as quack grass, Canada thistle and dandelion. Therefore, it makes sense to plan and implement a weed control strategy at least a year prior to seeding the forage crop. Herbicides and tillage in the year prior to establishment can be used to control annual and perennial weeds, however excessive cultivation loosens the seed bed and dries the soil.

Once the crop has been seeded, there are cultural and chemical methods to control weed problems. Forage crops are often weedy in the establishment year, due to lack of competition from the crop. If pre-establishment weed control was successful, the weeds present in the establishment year will be predominantly annuals.

Annual weeds can be controlled in the establishment year by using herbicides or mowing when weeds elongate, but prior to seed set. This type of cutting reduces competition and seed production of the weeds. Care should be taken to avoid mowing too low, as this damages forage seedlings.

Chemical weed control options in established forage stands are often limited, especially when a mixture of a legume and a grass is seeded, or when controlling grassy or broadleaf weeds in like forage crops. Management of forage stands to maintain a healthy, competitive stand goes a long way in reducing weed problems in established forage stands. Proper cutting schedules, good snow management, good fertility management, adequate rest periods after grazing or cutting, and appropriate stocking rates all will contribute to a healthy, weed free forage stand.

Perennial weeds in forages are more difficult to control. Quack grass is very difficult to successfully control in-crop using herbicides, however, maintaining a vigorous forage crop will limit it's spread in the field. Canada thistle can be controlled in most grasses by using herbicides, however, a healthy forage crop can usually eliminate Canada thistle from the stand within a couple of years. Foxtail barley has been an increasing problem on pastures in recent years. Use of herbicides on pastures that have been established for at least two years can be effective in eliminating foxtail barley. Refer to the Crop Protection Guide for recommendations on herbicides. Refer to product label for directions and restrictions before using any herbicide.

Inoculation of Legumes

Inoculation is the addition of effective rhizobium bacteria to legume seed prior to planting. After germination, the bacteria form nodules on the roots and begin taking nitrogen (N) gas from the soil air. The bacteria convert the gas to ammonium and give it to the plant. Well nodulated forage legumes can grow vigorously without the need for commercial nitrogen fertilizer.

Many Saskatchewan soils lack the specific rhizobia needed for rapid growth and high yields of forage legumes. Inoculation corrects these deficiencies by sticking thousands of highly effective N-fixing bacteria to each seed just before planting. The cost of inoculant is low and the potential yield benefits are substantial. Each legume or group of legumes requires a unique species of rhizobium to form nodules and fix nitrogen. Commercial inoculants are prepared for specific legumes. Make sure to obtain the right one for the crop being seeded.

Methods of Inoculation

Inoculant is a dry powder that is mixed with the seed just prior to planting. In order to be effective, it must be "glued" to the seed, so a sticker solution is used to bind the two together. Sticking agents like diluted sugar water, molasses, soda pop, etc., are used, but research has shown that a solution of ordinary powdered skim milk is very effective. If calf milk replacer is used, use a formulation without antibiotics.

Precise amounts of sticker are not important. Just mix the skim milk according to package directions (do not use hot water). Dribble (or spray) the milk on to the seed, wetting it thoroughly, and let the excess milk drain off. Turning the seed during this operation will ensure complete wetting.

Add inoculant to the wetted seed. Follow manufacturer's instructions for proper amounts. If seed is to be broadcast, or if seeding conditions are not ideal, increase the amount. Many growers routinely double the recommended rate of inoculant. Stir the seed and inoculant thoroughly, then proceed with seeding as quickly as possible. Small batches of wetted seed can be inoculated manually by mixing seed and inoculant in a large container or on a polyethylene sheet. For larger amounts of seed, cement mixers or ice augers can be used for mixing.

Inoculants may be available as peat powder, liquid, granules, or pre-inoculated seed.

Guide to Successful Inoculation

- Inoculate seed with the correct rhizobium.
- Use a sticking agent.
- Store inoculant in a cool dry place until use.
- Do not expose to direct sunlight.
- Inoculate seed just before seeding.
- Do not mix fertilizer with inoculated seed.
- Sow inoculated seed into a moist seedbed.
- Use more inoculant under adverse conditions.

Pre-inoculated Seed

Pre-inoculated seed of major forage legumes is commercially available. Seed should be stored appropriately to ensure viability of inoculant.

Using Annual Crops for Forage

Using annual crops for forage is a common practice in Saskatchewan. Crops such as barley, oats, triticale, peas, rye, corn, and many other crops are commonly grown and utilized as greenfeed, silage, pasture, or swath grazing in a livestock production system. Some producers have used annuals such as sorghum-sudangrass, millet, and kochia.

Annual crops are productive and flexible, allowing them to be used effectively to deal with sudden feed shortages. In order to obtain maximum profitability from annual forages, they require adequate levels of nutrients in the soil, particularly nitrogen in the case of cereals. If crops are stressed prior or during use, nitrate levels in the crop should be monitored to detect the presence of nitrates in the feed. Nitrates can poison livestock if present in high concentrations (0.5 per cent or greater).

Pasture

Annuals can be used for pasture, and fit well into complementary grazing systems. The choice of crop depends on when the additional pasture is required: fall rye sown in late August to early September will provide early grazing the next spring. Oats, barley (smooth awned varieties), wheat, spring rye or triticale sown in the spring is ready for pasture about seven weeks after planting. Spring-seeded fall rye or winter wheat will not go to seed, and will yield abundant leaf growth for mid and late season grazing. High stocking rates are required on annual forages to reduce trampling losses and prevent cereals from heading and losing quality. Rotational grazing is useful to achieve the required grazing pressure, and allow for plant recovery following grazing. Expected grazing productivity of annual pasture ranges from 25-150 grazing days per acre, depending on the soil zone.

Greenfeed

Annuals can be used for green feed production. Timing of cutting has a large impact on the subsequent feed quality. Considering the required feed quality prior to harvest will allow the operator to cut the crop at the appropriate time to maximize the benefit of the green feed crop. Generally speaking, fiber content increases and protein and energy decreases as annual cereal forages go from boot to hard dough stage. Barley protein

and energy levels decline more slowly than oats, triticale, and rye.

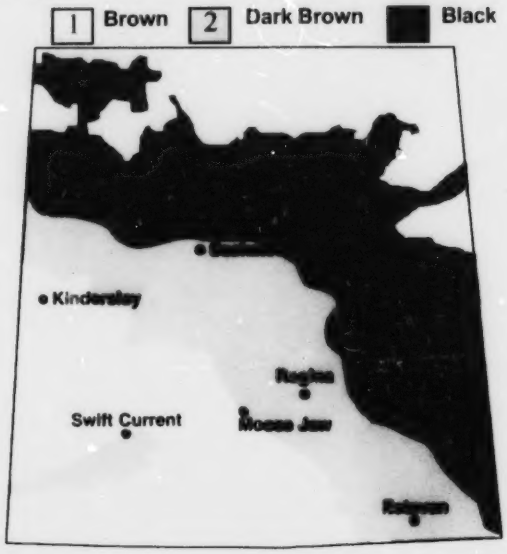
Generally, annual forages product the highest yields and protein when harvested in the dough stage. The relative performance of annual species varies with soil zone. For instance, in the Dark Brown and Brown soil zones, barley usually has greater yield than oats, however, in the Black and particularly Gray Wooded soil zones, oats usually out yields barley.

Protein, total digestible nutrients (TDN), and fiber (acid detergent fiber, neutral detergent fiber) content of cereal greenfeed

Crop	Protein (%)	TDN	ADF	NDF
barley	11.2	58.4	37.3	58.1
oats	10.8	57.0	37.6	60.9
rye	8.7	53.8	42.3	66.3
wheat	10.6	55.7	37.6	63.1

Soil Zones of Saskatchewan

Forage Crop Soil Zones

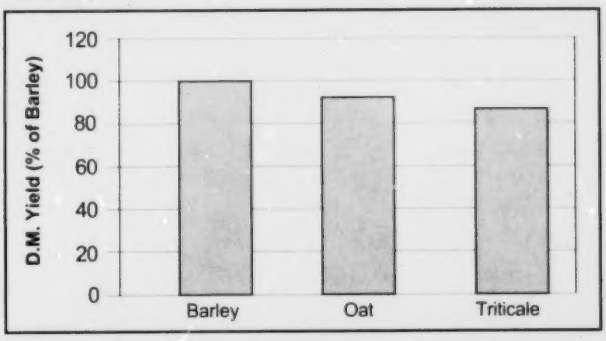


Dry matter yield of annual crops as greenfeed, Black Soil Zone

Crop	Yield (kg/ha)
barley	5000-7500
fababeans	2500-4500
Italian ryegrass	4600-4900
oats	5600-9800
peas	5600
Proso millet	3100-5600
canola	300-4200
Sorgum-sudangrass	3200-5300
spring rye	5900-6100
sunflowers	1200-2900
triticale	5600
wheat	2600-6800

Agriculture and Agri-Food Canada Data, Melfort

Dry matter yields of annual cereals grown for forage expressed as a per cent of barley yield - average of 15 site years of data from North West Saskatchewan, 1992-96.



Relative Yield of Annual Cereals in the Black Soil Zone
(Canora/Melfort)

Species	Variety	Forage Yield (% of check)	
		Canora	Melfort
Wheat and Triticale	CDC Teal Wheat	100	100
	Genesis Wheat	99	90
	Frank Triticale	105	83
	yield of Teal (kg/ha)	7,034	12,530
Oats	CDC Bell	100	100
	CDC Pacer	101	101
	AC Mustang	92	92
	yield of Bell (kg/ha)	9,229	9,229
Barley	Virden	100	100
	AC Rosser	101	101
	AC Lacombe	97	97
	CDC Earl	97	97
	CDC Dolly	92	92
	Bonanza	91	91
	Manley	91	91
	Seebe	90	90
	yield of Virden (kg/ha)	10,386	10,386

Swath Grazing

In recent years, swath grazing has developed into a popular technique to extend the grazing season. Swath grazing involves cutting an annual or perennial crop late in the season and allowing the crop to remain in swath. Cattle graze the swaths in late fall or winter. Annual cereals are commonly used for swath grazing. Swath grazed crops are usually planted later than other annual cereals, so that they are ready to be cut in September. When swath grazing, stock densities must be kept high with the use of electric fencing to reduce trampling losses and wastage.

Silage

All cereals, corn, peas and other field crops are commonly used as silage. Barley is the dominant silage crop in Saskatchewan due to it's high yield and good quality. All annual silage crops have different quality characteristics that influence the composition of the end product. Operators should determine the desired quality of silage, then select the crop that will provide the desired quality and acceptable yield. Crops can be grown in mixtures for silage to enhance silage quality or provide additional forage resources. Peas are included with cereals to increase protein content, and tritcale is sometimes included with other cereals to provide late summer grazing after the silage crop is removed.

Annual Ryegrass for Pasture in Saskatchewan

Annual ryegrass is grown in many areas of the world as a forage and seed crop. In recent years, this species has been grown in Saskatchewan as summer and late season pasture, and as a seed crop.

Annual ryegrass is adapted to the Black and Grey-wooded soil zones of Saskatchewan. There are two types of annual ryegrass: Italian ryegrass is a biennial that usually does not develop seed heads until the crop has been vernalized; and Westerwolds ryegrass is a taller, stemmier type which will develop seed heads in the year of seeding.

As both types have limited winter hardiness under Saskatchewan growing conditions, they will not successfully overwinter and are considered annual crops. Adequate moisture and soil fertility are required to achieve maximum productivity of this species. Detailed yield information is presently being obtained for the several varieties of annual ryegrass available, however Maris Ledger (Italian type) and Aubade (Westerwolds type) have been successfully grown in Saskatchewan.

Annual ryegrass can be used for hay, silage or pasture, but the Westerwolds type is better suited to haying due to it's tall growth. Annual ryegrass production peaks in late July and early August, with growth continuing late into the fall. This growth pattern, in addition to the high quality forage produced (crude protein levels in excess of 20 per cent in fall regrowth), makes grazing into winter possible.

Annual ryegrass is best seeded in mid-May at a depth of 1.5 to 3 cm, depending on soil moisture conditions. Stands should be fertilized at the same level as a cereal crop to realize full production potential. Recommended seeding rate is 10-12 pounds per acre. Annual ryegrass can also be underseeded to cereals used for greenfeed, silage, or grain, to provide late season grazing after harvest.

Fertilizing Forages

Forages require nitrogen (N), phosphorus (P), potassium (K), sulphur (S) and micronutrients. Most Saskatchewan soils are low in N and P, many are low in S, and some are low in K and may be low in one or more micronutrients. Properly inoculated alfalfa will not require N fertilizer.

Soil testing is the best way to assess soil nutrient levels. Crop inspecting and tissue testing allow for fine-tuning fertilizer application and problem diagnosis. Some soil testing labs will do an economics report on fertilizer application, for a nominal fee, which analyzes the benefit versus the cost of applying fertilizer.

Establishment Year

With good to excellent soil moisture, only 15 lb P_2O_5 can safely be placed with forage seed, using equipment with a 6 to 7 inch row spacing and one inch spread. All other fertilizer should be banded away from the seed (side banded or deep banded) or broadcast and incorporated. Banding often results in greater N, P and K fertilizer use efficiency.

Established Forages

N and sulphate-S are mobile nutrients (will be carried into the soil by rainfall), thus can be top dressed annually after establishment of the forage; though significant losses of N can start to occur if rainfall is not received within 1 to 2 days of application. Top dressed ammonium nitrate (34-0-0) is usually more effective than top dressed urea (46-0-0).

Spraying liquid N (28-0-0) is not recommended on established forages. Dribble banding liquid N is considered more effective.

Placing N in the soil using a spoke-wheel applicator or disc bander should avoid the potential problem of N loss through ammonia volatilization. Banding with knives, however, has been shown to be a poor alternative. It was less effective than disc banding for fall application, and less effective than top dressing for spring application.

Grasses for hay or pasture should be fertilized with N in late fall or early spring. When a high rate of N will be applied (greater than 100 lb actual N per acre), split

Perennial Forages for Saline Soils, Flooded Areas and Peat*

Salinity Rating**	Crop or Mixture	Approximate Seeding Rate for Hay or Pasture lb./acre or kg/ha
Slight to Moderate	**Soils with Minor Spring Flooding (up to 2 Weeks)**	
(2-6 mmhos.)	Bromegrass + Russian wildrye grass + Alfalfa (creeping rooted)	4 + 4 + 4
	Bromegrass + Slender wheatgrass + Alfalfa (creeping rooted)	4 + 4 + 4
	Russian wildrye grass + Alfalfa	6 + 3
	Altai wildrye grass + Alfalfa	10 + 3
	Crested wheatgrass + Alfalfa	7 + 3
	Altai wildrye grass	11
	Slender wheatgrass + Sweetclover (short-term stands and not over 1 week flooding)	8 + 6
Severe (6-15 mmhos.)	Bromegrass + Russian wildrye grass + Slender wheatgrass	4 + 4 + 4
	Crested wheatgrass + Altai wildrye grass + Tall wheatgrass + Alfalfa	4 + 4 + 4 + 2
	Altai wildrye grass + Alfalfa	10 + 3
	Tall wheatgrass (moist districts or seepage areas)	12
Little or None	**Spring Flooded (2 – 5 Weeks)**	
(up to 2 mmhos.)	Reed canarygrass + Bromegrass	4 + 6
	Reed canarygrass + Timothy	4 + 4
	Timothy + Bromegrass	4 + 6
	Altai wildrye grass + Alfalfa (2-3 weeks maximum flooding)	10 + 3
	Altai wildrye grass	11
	Timothy + Alsike	5 + 2
Slight to Moderate (2-6 mmhos.)	Reed canarygrass + Bromegrass	4 + 6
	Reed canarygrass + Bromegrass + Slender wheatgrass	4 + 6 + 6
	Altai wildrye grass + Alfalfa	10 + 3
	Altai wildrye grass	11
Severe (6-15 mmhos.)	Altai wildrye grass + Alfalfa	10 + 3
	Slender wheatgrass	8
	Altai wildrye grass	11
	Tall wheatgrass	12
Little or None	**Spring Flooded (5 – 8 Weeks)**	
(up to 2 mmhos.)	Reed canarygrass	5
	Reed canarygrass + Timothy + Slender wheatgrass	3 + 3 + 6
Slight to Moderate (2-6 mmhos.)	Reed canarygrass + Slender wheatgrass	4 + 6
	Tall wheatgrass	12
	Peat, Poorly Drained Soils	
	Timothy + Alsike clover	5 + 2
	Timothy + Bromegrass + Slender wheatgrass + Alsike clover	3 + 5 + 5 + 2
	Timothy + Bromegrass + Alsike clover	3 + 6 + 2
	Reed canarygrass + Timothy	4 + 3

* Six inch row spacings are recommended in salinity seedings.

** Ratings for salt content in millimhos per centimetre conductivity. Salt content reading can only be determined by obtaining a soil test from Envirotest Laboratories.

application will result in higher forage protein content, and sometimes higher yield.

N fertilization of mixed legume-grass forage stands is difficult, because N application stimulates grass production and reduces the longevity of the alfalfa. Also, the alfalfa in the stand will use some of the applied N, reducing the amount of N it fixes from the air, increasing the cost of supplying the stand with N.

The yield response of mixed forage stands to N application depends on the percentage of legume in the stand, soil N level, soil type and forage species. Generally, mixed stands that are more than half alfalfa respond little to N fertilizer application. Yield responses are greatest on stands with a low percentage of alfalfa and low soil N.

When soil testing mixed forage stands be sure to indicate the approximate percentage and species of legume and grass.

P does not move easily into the soil, thus planning a fertilizer program is important for grass, legume and mixed stands. The options for P fertilizer application are:

- Band or broadcast and incorporate more than 1 year's supply of P prior to forage establishment.
- Band P with a disc bander, dribble band liquid P, or nest P with a spoke wheel applicator, annually.
- Top dress 2 to 3 X the amount of P required when banding, annually. K moves into the soil more quickly than P, but much less readily than N; thus application options are similar to those for P.

Approximate nutrient removal per ton of air dry forage*

	Amount removed (lb/ton)	
Nutrient	**Alfalfa**	**Grasses**
Nitrogen (N)	50	35
Phosphate (P_2O_5)	10	10
Potassium K_2O)	50	50
Calcium (Ca)	30	7
Magnesium (Mg)	5	5
Sulphur (S)	5	5
Iron (Fe)	0.3	0.3
Manganese (Mn)	0.1	0.1
Boron (B)	0.08	0.08
Zinc (Zn)	0.05	0.05
Copper (Cu)	0.01	0.01
Molybdenum (Mo)	0.002	0.002

*Nutrient removal is an indication of nutrient requirement, but not a recommendation for fertilizer application. Recommended application rates of fertilizer based on a soil test also consider fertilizer use efficiency, availability of nutrients in the soil, etc.

Seeding Forages in Saline Areas

Saline patches that appear in annually cropped fields may steadily enlarge if management practices remain the same. Converting this land to forages is much more successful if done while the affected land still supports barley crop production.

Late fall seeding of saline areas is desirable, since early spring snowmelt temporarily decreases salinity concentrations.

Seeding mixtures of two, three or even four varieties of grasses and legumes is recommended. Non-saline tolerant species (alfalfa, crested wheatgrass) should be included in salinity mixtures so they can establish around seep edges and in pockets of better soil.

Nearby water recharge areas should be identified and seeded to tap-rooted alfalfa.

Land Reclamation

Land reclamation can be considered any activity with a primary goal of reestablishing vegetation on sites that have had major disturbance. Common disturbances in Saskatchewan that require subsequent reclamation include oil and gas drilling, logging, mining, pipeline development, gravel pits, and road construction.

Land reclamation activities often occur on areas that have native vegetation present. The goal of reclamation should be to return the disturbed areas to as close to original condition as possible and reduce the risk of erosion on the site during and after reclamation activities are complete. Some factors to consider when reclaiming land include:

- Minimize disturbance on the site to reduce the amount of reclamation required.
- Use good topsoil conservation techniques.
- Select species with characteristics that are suitable for the area where they will be established. Salinity tolerance, drought tolerance, and competitive ability are all factors to consider. Some effort should be made to select species that were present on the site prior to disturbance. This to ensure the appearance and grazing value of the reclaimed area will be similar to the surrounding area.
- Some species are invasive, and will spread into surrounding areas by seed production or by spreading rootstocks. Avoid use of long-lived, aggressive species when reclaiming areas in or adjacent to sensitive areas.

- Use certified seed, or obtain the weed seed content of the seed to be purchased to ensure that the seed lot is clean and that problem weeds are not present.
- Plan to use erosion control measures until the seeded area has a chance to become established.
- Refer to reclamation guides for further guidelines.

Improved Grazing Management - More Pasture for More Months

Economical production of high yielding, quality forage is a necessity for a successful livestock operation. Grazing management is one of the cornerstones of successful forage production. Since feeding costs are the single greatest expenditure in a cattle operation, management of the grazing resource has large impacts on the financial success of the operation.

Forage plants require certain conditions to survive and produce to their potential. Managing a forage stand for livestock production is a balancing act; providing growing conditions that allow the forage species to maintain its vigour while providing a satisfactory level of forage for the grazing animal. The manager controls grazing by regulating the *season*, *intensity* and *frequency* of grazing on a pasture. *Species* of forage and *past use history* will influence how the pasture will react to management.

The *season* of use should take into account the particular species being grazed. Each forage species has growth characteristics that make it conducive to grazing during certain times of the year. For example, crested wheatgrass is well suited to spring grazing, while native range is best suited to summer or fall grazing. If necessary, forage species can be grazed outside their optimal grazing period, however, the subsequent rest period must be longer to avoid decline in the health of the forage stand. The rest period must occur when growing conditions allow for growth and recovery of the pasture. Growth periods of common forage species in Saskatchewan are shown on page 18.

Intensity refers to the amount of vegetation removed in a grazing season. Most tame forage species can have up to 70 per cent of the above ground vegetation removed, while native range should have lower levels of utilization, in the range of 50 per cent. Forage can have higher levels of utilization imposed on them, but again, the subsequent rest period needs to be longer to account for the additional stress put on the plant. In the case of native range, early season grazing or high levels of utilization will require rest periods of one and a half years or more to allow for adequate recovery.

Frequency of grazing, or the rest period between grazing events is an important consideration when grazing forages. Factors such as the species of forage, growing conditions, rainfall, intensity and timing of grazing will all influence the rest period required on a pasture.

Stocking Rates

The stocking rate is the number of animals on an area of land for a given period of time. Setting a stocking rate involves balancing forage removal with forage production, and should accurately reflect the production capacity of the pasture. Stocking rates are affected by the species of forage, age of the stand, soil zone and texture, fertility levels and growing conditions.

Animal Distribution

Animal distribution is the degree of use by livestock of all areas of a pasture. It is desirable to have even distribution across all areas of the pasture. Uniform animal distribution reduces selective grazing—this occurs when livestock over-utilize the most palatable plants and under-utilize the rest. Uniform animal distribution also reduces waste of forage. Areas located far away from water sources or areas difficult to access by livestock will not be used, while areas more accessible are overused and will decline. Animal distribution can be improved by increasing the number of livestock in a pasture and reducing the amount of time they are in it. Pasture size can also be reduced while maintaining herd size. Both of these techniques more effectively increase stock density.

Other methods to improve animal distribution include locating salt in under-utilized areas of the pasture and burning or fertilizing under-utilized areas to increase their palatability and attractiveness to livestock. Developing new water sources or limiting access to existing ones is an effective way to change use patterns of livestock.

Balancing Forage Supply and Demand

Feed costs are a major expense in any beef operation. The longer livestock can remain on pasture and harvest their own forage, the lower the cost of feeding. This indicates that most producers should attempt to develop a supply of adequate quality grazing starting as early in the spring as economically possible and as late as possible in the season.

Developing a forage budget to help identify periods in the grazing season when there may be a deficiency is useful. As these deficient periods are identified, grazing resources can be developed to address the deficiency. For instance, if early spring grazing is lacking, marginal farmland can be seeded to crested wheatgrass. If late season grazing is required, altai or Russian wildrye grass can be seeded. To calculate a forage budget, it is useful to use the Animal Unit Month (AUM) as a way of determining forage use and planning grazing strategies.

One AUM is defined as one 1,000 lb. cow (with calf at foot) grazing for one month. Thus a quarter section that is rated at 48 AUM can carry eight cows for six months. Alternately, the same pasture can carry 12 cows for four months, or any other combination equal to 48 AUM. To calculate AUM, the following conversion rates are used:

1 – 1000 lb. cow (with calf)	1.0 AUM
1 – yearling steer or heifer	65 – .75
1 – bull	1.5
1 – horse	1.5
5 – ewes (with or without lambs)	1.0

Note: AUM value is adjusted upwards for larger cows, for example a 1,200 lb. cow would be 1.2 AUM. Calves account for significant forage removal by mid to late season, this is particularly true in early calves.

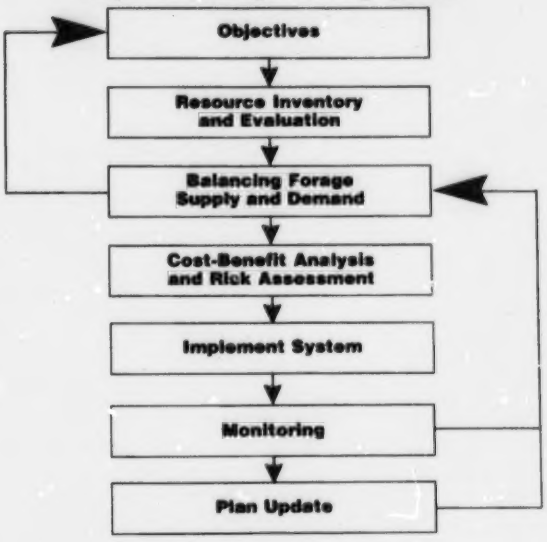
Grazing Systems

A grazing system can be described as a conscious effort to influence the time, space, duration and intensity of grazing events on an area of land to suit some type of management goal. Successful grazing systems integrate a number of tools and resources to achieve well-defined goals. A common goal in many grazing systems is to have high livestock performance at acceptable costs and risks, while improving or at least maintaining pasture productivity.

Planning is the First Step

There are many types of grazing systems with varying levels of complexity, however, before any one grazing system is selected, planning must occur to determine which grazing system is most suitable to the production unit. Every unit is different and a generalized grazing system should be custom tailored to the features and resources present on each farm or ranch. The following is a generalized diagram for the planning process.

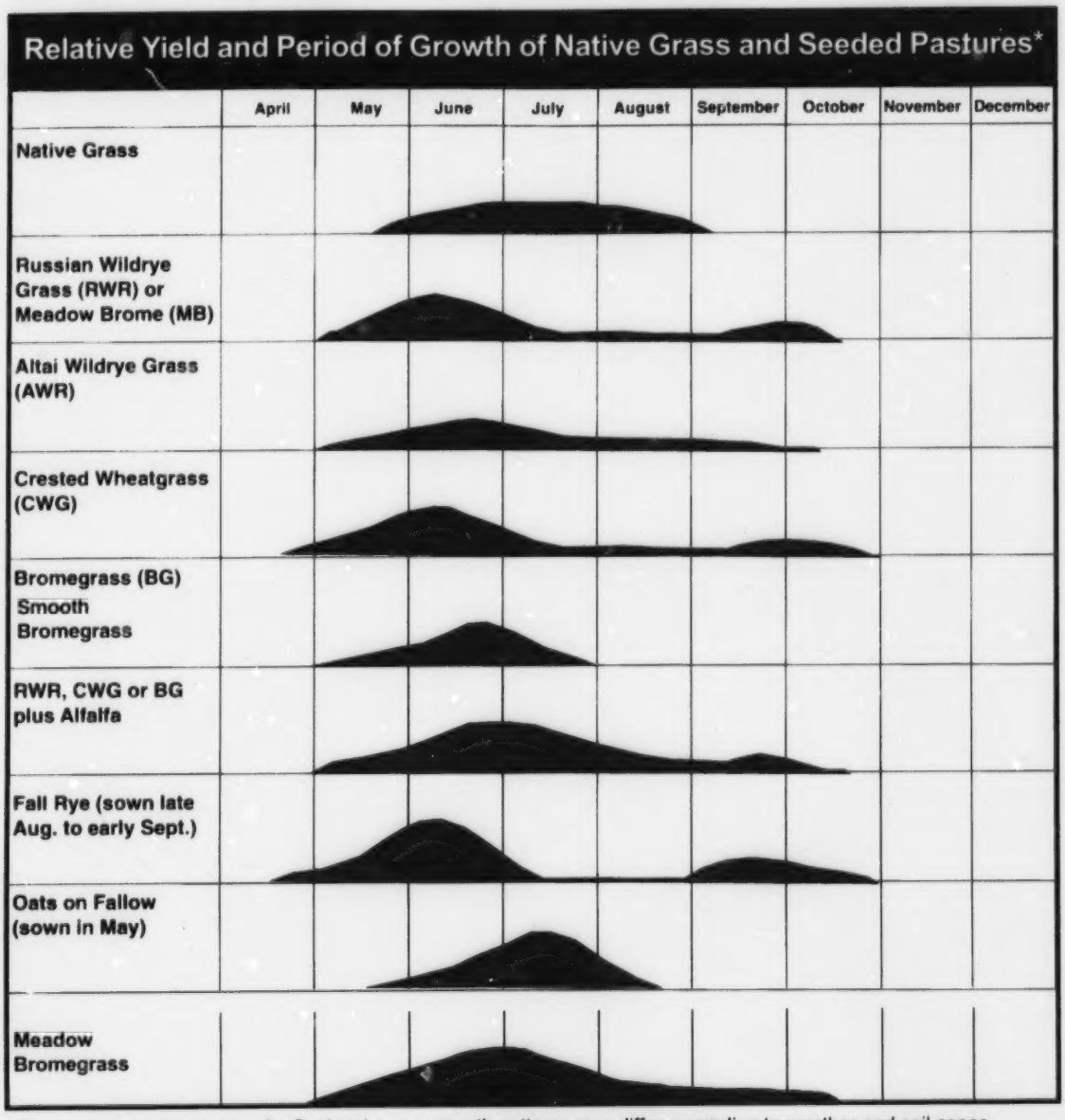
Steps in Planning a Grazing System



Haying – Cutting for Maximum Quantity and Quality

A major goal of haying is to maximize tonnage of harvested forage. Forage quality is also a very important component of successful haying. Striving for high tonnages of hay while also trying to maximize protein and nutrient harvest is a good practice. Determining when to harvest to maximize both dry matter yield and nutrients can be done if the relationship between dry matter accumulation and protein content dynamics in the crop are understood. Generally, dry matter accumulates during the growing season and peaks late in the season.

Conversely, forage quality is very high early in the season and declines as the season progresses. The goal is to determine at which point in time these two lines intersect. This point will determine when the best compromise between yield of dry matter and nutrients will occur. In Saskatchewan, this point occurs usually in the third week of June, but this date may vary depending on the species of forage and the growing conditions. In the case of alfalfa, the point at which 10 per cent of the flowers on the plant are blooming is the best time to cut for maximum quality and yield. In the case of most grasses it is best to cut after the boot stage, but before heading.

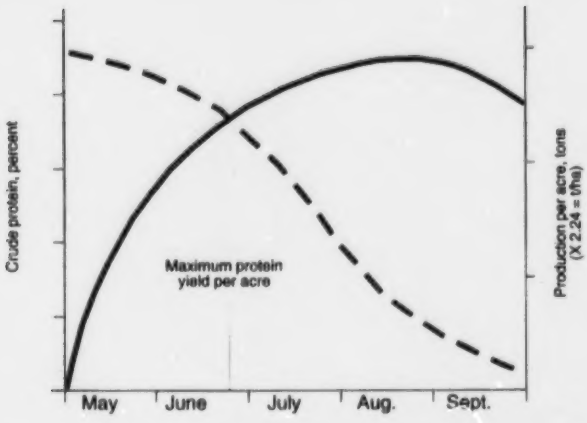


* These curves are averages for Saskatchewan, growth patterns may differ, according to weather and soil zones.

Bloat

Bloat is a potentially lethal expansion of the stomach in ruminant animals, which can occur after they have eaten large quantities of legume forage. Legumes can create a stable foam in the rumen, which blocks the normal escape of gas. Fear of bloat causes many producers to avoid use of forage legumes; however, most of the specific situations that cause bloat can be avoided.

- Do not turn livestock directly on to a lush, vigorously-growing legume field. Make sure the animals are already fed when they go on, and avoid putting them on in the morning, when dew increases plant moisture content.
- Seed pastures to a mixture of grasses (e.g. meadow bromegrass) and legumes, to reduce legume intake.
- Where appropriate, feed bloat control products containing poloxalene or Rumensin.
- Consider use of non bloating legumes (sainfoin) or low-growing types (certain clovers, cicer milkvetch). Certain breeds and strains of livestock seem to be prone to bloat. Bloated animals can be saved if prompt action is taken, in consultation with a veterinarian.



Relationship between forage yield and forage quality.

* from Cultivation and Management of Cultivated Forages, Walton, 1983.

Nitrate Poisoning

Frosted green oats can cause nitrate poisoning. Barley, wheat, corn, flax sorghum and other forages, and some weeds, such as lamb's quarters, kochia and Russian thistle, can also be poisonous. Plants take up nitrogen as ammonium or nitrate. Under favourable growing conditions, plants quickly converts nitrate to non-toxic compounds. Poor growing conditions (drought, hail, or frost) can cause nitrate to accumulate. When conditions improve and the plant starts growing again, nitrates are quickly used up.

When livestock consume forage containing nitrate, their ability to absorb oxygen is reduced. Symptoms of mild nitrate poisoning included restlessness, frequent urination and watery eyes. Acute poisoning causes extreme weakness, blue coloration of eyes and mouth, shortness of breath, and finally death. Nitrate poisoning can be treated by prompt injection of aqueous methylene blue by a veterinarian.

Nitrate poisoning can be avoided by taking these precautions:

- Feed animals first before turning them out on lush or stressed annual pasture, cereal aftermath, or swath grazing.
- Check the herd frequently during initial period and consider supplementary feeding.
- Have stored hay, especially frozen cereal forage, analyzed by a laboratory. Forage samples can also be spot tested by local extension agrologists. It is a good management practice to have all forages analyzed.
- Feed containing 0.5 per cent or more nitrate is considered dangerous. The hazard can be reduced by mixing high nitrate feed with other fodder low in nitrates.

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USE CERTIFIED SEED

References

The following references can be obtained free of charge from Saskatchewan Agriculture and Food by calling **1-888-613-3975**.

Species Adaptation and Management

Alfalfa Production for the Dehydration Industry 1997 .
Alsike Clover. Publ. 1264, 1980.
Altai Wildrye Grass. Contribution 1983-3E.
Annual Ryegrass Production in Saskatchewan.
Creeping Red Fescue. Publ. 1122.
Crested Wheatgrass. Publ. 1295. Contribution 1983-18E.
Dahurian Wildrye Grass.
Diseases and Nutrient Deficiencies in Alfalfa for Forage.
Forage Selection. 1990.
Growing and Managing Alfalfa in Canada Publ. 1705, 1980.
Growing Russian Wildrye Grass in Western Canada. Publ. 1435, 1991.
Intermediate Wheatgrass. Contribution 1983-2E.
Marketing Hay
Red Clover Production. Publ. 1614.
Reed Canarygrass. Publ. 805, 1981.
Re-Grassing Farmland: A Practical Guide to Selecting the Right Forage Species.
Rejuvenation of Tame Forages: Southern Saskatchewan.
Russian Wildrye for Pasture. ISBN 088656-662-2.
Sainfoin for Western Canada. Publ. 1470.
Seeded Native Range Plants.
Sweetclover Production in Western Canada. Publ. 1613/E.
Timothy. Publ. 1640.
Varieties of Perennial Hay and Pasture Crops for Alberta. Agdex 120132.
Tame Forage Rennovation: Parklands. 1997.
Relative Feed Value – A Tool for Determining Alfalfa Quality

Grazing Management

Forage Management. 1990.
Grazing Systems for Rangelands of Southern Saskatchewan.
Initial Stocking Rate Recommendations for Seeded Forages in Saskatchewan.
Managing Saskatchewan Rangeland.
Range Plan Development.
Planning for Balancing Forage Supply and Demand.
Economics of Managing Crested Wheatgrass Pastures Infested with Wolf Plants.
Economics of Clubmoss Control on Saskatchewan Rangelands.

Salinity

Nature and Management of Salt-Affected Soils in Saskatchewan.

Establishment

Forage Establishment. 1990.
Air Seeding Forage Crops. PAMI #733.

Weed Control

Bark Scrape to Manage Aspen.
Crop Protection Guide.
Management of Pasture Sage.
Wiper Applied Herbicides to Manage Brush.
Foxtail Barley in Forages.
Control of Pasture Sage.

Annual Forages

Rye: Grain and forage for seed.
Oat Production

Reclamation

Seeded Native Range Plants.
Restoration of Saskatchewan Agricultural Crown Rangeland.

Revised in 2001 by M.L. Tremblay, Saskatchewan Agriculture and Food, in consultation with the Saskatchewan Advisory Council on Forage Crops.